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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/974,808	10/12/2001	Yoshiaki Yamada	PF-2200DIV	9978

466 7590 01/12/2004

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EXAMINER

BREWSTER, WILLIAM M

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 01/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	09/974,808	YAMADA ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	William M. Brewster	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 18 November 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All   b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.  
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

#### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                     | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                            | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>101201</u> | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Specification***

The disclosure is objected to because of the following informalities: on page 3, line 22, replace, "nitratio" with --nitration--.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 1, 2, 6, 7 are rejected under 35 U.S.C. 102(e) as being anticipated by Chang et al., U.S. Patent No. 5,672,543.

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Chang anticipates, in fig. 8, a contact plug structure 28 in a contact hole in an inter-layer insulator 20 on a silicon substrate 10, said contact plug structure comprising a titanium film 24 on a bottom and a side wall of said contact hole; a titanium nitride film 26 on said titanium film; a metal plug 28 on said titanium nitride film so that said metal plug buries said contact hole, col. 2, line 58 - col. 3, line 63; and a titanium silicide layer in a surface region of said silicon substrate and in contact with a bottom of said contact hole (inherently when the titanium is deposited and subjected to an elevated temperature, 450° C - 660° C, a few atomic layers of titanium and silicon will alloy to form a silicide layer, col. 4, lines 8-25), wherein said titanium nitride film free of any crack and has a tensile stress of not higher than  $5 \times 10^9$  dyne/cm<sup>2</sup>, TABLE 1, Ti/TiN deposit column, col. 4, lines 25-40,

limitations from claim 2, 6, 7: wherein said compressive stress of said titanium nitride film is not higher than  $3 \times 10^9$  dyne/cm<sup>2</sup>, not higher than  $2 \times 10^9$  dyne/cm<sup>2</sup>, (2.145 is within a standard deviation of 2) TABLE 1, Ti/TiN, after Furnace (450° C) column, col. 4, lines 25-40.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3, 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al., as applied to claims 1, 2, 6, 7 above, and further in view of Kamata, U.S. Patent No. 5,244,820.

Chang does not specify forming titanium nitride film oriented in a (200) face, but Kamata does. Kamata teaches forming titanium nitride film oriented in a (200) face and gives motivation in col. 30, lines 33-60. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to recognize that combining Kamata's process with Chang's invention would have been beneficial because (200) orientation can diminish the precipitation of Si and has superior heat resistance.

Claims 4, 5, 9, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al., as applied to claims 1, 2, 6, 7 above, and further in view of Miyamoto, U.S. Patent No. 5,747,384.

Chang does not specify the aspect ratio of his contact hole, but Miyamoto does. Miyamoto teaches, in fig. 9, a multilayer structure on a bottom of a contact hole, said multilayer structure comprising a titanium film 15 on a silicon region 11 and a titanium nitride film 18 on said titanium film, col. 8, line 36 - col. 9, line 33, wherein said contact hole has an aspect ratio of not less than 4 or 5, col. 8, lines 36-52. Miyamoto gives motivation in col. 1, lines 28-37. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to recognize that combining Miyamoto's process with Chang's invention would have been beneficial because it is necessary for high integration of semiconductor devices.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to William M. Brewster whose telephone number is 703-305-5906. The examiner can normally be reached on Full Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone number for the organization where this application or proceeding is assigned is 703-305-3432.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

*William M. Brewster*

WB

5 January 2004